

5. Note on the Mode of Attachment of the Embryos to the Oral Arms of *Aurelia aurita*. By EDWARD A. MINCHIN, Keble College, Oxford.

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(Plates LVII. & LVIII.)

Some little while ago, when engaged in dissecting a series of *Aurelia aurita* in the Morphological Laboratory at Oxford, I noticed that a great number of the specimens supplied had the oral arms covered with little knobs or swellings, which, though varying greatly in size in different specimens, were always, when present, quite visible to the naked eye. I was unable at the time to obtain any information as to the meaning of these appearances, and therefore proceeded to investigate them by cutting sections of the arms. I then found that the knobs were really little stalked capsules or pouches containing embryos of *Aurelia*, formed as evaginations of the wall of the groove running down the arm, and with their lumen communicating with that of the groove through the more or less narrowed stalk. This is readily seen from the annexed figures. Fig. 1, Plate LVIII., represents an oral arm covered with the brood-capsules, drawn about three times natural size. Fig. 2, Plate LVII., represents a transverse section of an oral arm which bore no brood-capsules, in order to show the structure of the arms—namely, ectoderm (*ect.*) externally, endoderm (*end.*) lining the lumen of the groove internally, and between the two mesogloea (*mes.*), which is very thick at the bottom of the groove. The margins of the groove are produced into numerous “digitellæ” (*d.*), finger-like processes of the ectoderm, containing a core of mesogloea and thickly covered with nematocysts. Fig. 3, Plate LVII., represents a transverse section from an arm which bore very few, and comparatively small, brood-capsules. Two capsules are seen on the left side of the figure, one of which (*a*) is cut through its stalk, and the other (*b*) a little to one side of it. Figs. 4 and 5, Plate LVII., represent in outline two more sections from the same series through the brood-capsules *a* and *b* of figure 3, in order to show the way in which *a* becomes closed off from the groove (fig. 4) and *b* becomes bifid (fig. 5). Fig. 6, Plate LVIII., represents one side of a transverse section through an oral arm which bore numerous, and relatively very large, brood-capsules. Four of the capsules appear in the section, one of them (*e*) cut through the middle of its stalk, two others (*c* and *d*) just to one side of their respective stalks, and a fourth (*f*) so far from its stalk that it appears as if detached from the arm altogether.

From these figures it is evident that the capsules are formed as simple evaginations of the walls of the groove of the oral arm. They are hence lined by endoderm internally and ectoderm externally, with more or less mesogloea between the two. In the smaller

capsules, such as are represented in figures 3, 4, and 5, the walls are relatively thick, containing a great deal of mesogloea, and the capsules themselves open by a comparatively wide opening into the lumen of the groove. In the larger capsules, on the other hand (figure 6), the mesogloea is scarcely visible, appearing as if squeezed out by the pressure of the numerous embryos contained in the capsules, and their openings are much narrowed. They always contain embryos in all stages of development, from segmenting ova to fully-formed plaulæ. In the series of sections from which figures 3, 4, and 5 were drawn, several ova were found of only four or eight segments. In addition to the embryos contained in the brood-capsules, a great number are always to be found free in the bottom of the groove or lodged in the foldings of its margin.

My excuse for publishing these details is that after I had made out the structure of the pouches from my sections, I consulted the numerous works on the anatomy and embryology of *Aurelia*, and found the brood-capsules quite erroneously described by Claus and Agassiz; while in other writers I have found no mention of them at all.

Claus ('Untersuchungen über die Organisation und Entwicklung der Medusen,' Prag, 1883) writes:—"The ova pass from the ovary into the gastric cavity and through the mouth between the apposed surfaces of the arms, where, surrounded by a slimy excretory product of the endoderm (von einer schleimigen Absonderungsmasse des Entoderms umhüllt), they run through their embryonic development up to the swarming planula, as if in a brood-cavity." I find this account to be incorrect, as far as my specimens go.

Agassiz ('Contributions to the Natural History of the United States,' vol. iv.) states (pp. 14 and 15) that the embryos of *Aurelia flavidula* leave the ovary as small ciliated larvæ, either globular or oval in shape, and *with distinct inner and outer walls*¹; in this condition they reach the pouches. In another passage (p. 58) he says:—"The ovaries . . . discharge their eggs into the cavity above that floor [*i. e.* of the genital sacs], from which they have no other escape than through the channels leading into the main cavity of the body, from which they pass along the medial canals of the arms into *the pouches formed by the foldings of their margin*¹, where they undergo their first development." In figure 9 of his plate viii. he represents some of the pouches containing "eggs and planulæ." Speaking of *Cyanea*, he says:—"The eggs of *Cyanea* are able to lodge between the plications of the inner surface of the actinostome, though not provided with special pouches as in *Aurelia*." Thus Agassiz clearly recognized the fact that the embryos of *Aurelia* are carried in special pouches; but he wrongly describes their formation as foldings of the margin of the arm; and, moreover, he states that the embryos do not reach them till they have attained the planula condition. If this is the case in *Aurelia flavidula*, it certainly is not so in *A. aurita*. I have succeeded in finding in the pouches embryos in all the stages described and figured by Claus

¹ The italics are not Agassiz's.

(*loc. cit.*), from segmenting ova to the fully formed planulæ or "clistogastrulæ."

Other Medusæ belonging to the Acraspeda carry their ova about during the first stages of development. Von Lendenfeld states (Proc. Linn. Soc. N. S. Wales, vol. ix.) that in *Pseudorhiza* "the embryos are carried about in pouches suspended in great number from the radial canals which run centripetally from the ring-canal. They remain there till they are fit to turn into young Scyphistomes." In *Stylorhiza* (*Phyllorhiza*) *punctata*, he says (*loc. cit.*), "the young embryos adhere to the mother's filaments until they have nearly attained the *Scyphistoma* stage." The same author describes ('*Zeitschrift für wiss. Zoologie*, 1888, p. 301) in *Cyanea anaskala* and *Phyllorhiza punctata* a peculiar arrangement of filaments on the underside of the arms, by which the embryos appear to be nourished.

P.S., Dec. 9, 1889.—Since writing this article my attention has been directed to Ehrenberg's paper, "Ueber die Akalephen des rothen Meeres und den Organismus der Medusen der Ostsee" (Phys. Abhandl. Akad. Berlin, 1835). Ehrenberg gives a rough figure of *Aurelia aurita* showing a magnified external view of the pouches and their contained embryos (Taf. viii. fig. 1, and Taf. iii. fig. 1); and states (p. 197), first, that the brood-pouches are either formed by the pressure of the "Kugeln" (*i. e.* ova and embryos) which collect in the groove of the arms, or else are preformed by the mother for their reception; secondly, that the pouches increase in size as more embryos crowd in; and thirdly, that when the embryos quit the pouches the latter collapse and disappear.

EXPLANATION OF PLATES LVII. & LVIII.

In all the figures *ect* denotes the ectoderm; *mes*, the mesogloæ; *end*, the endoderm; *d*, digitellæ; and the letter *G* is placed in the lumen of the groove of the arms.

- Fig. 1. An oral arm of *Aurelia aurita*, covered with the little pouches containing embryos. The letter *m* is placed in the cavity of the mouth.
2. A transverse section of an oral arm which was entirely without brood-pouches. The numerous plications are due to the arm having been crumpled while preserved in spirit.
 3. A transverse section of an arm which had few and somewhat small pouches. *a* and *b*, two of the pouches containing embryos.
 - 4 & 5. Two more sections through the pouches lettered *a* and *b* in the last figure.
 6. A transverse section through an arm which had numerous and very large brood-pouches. Only one side of the section is drawn. *c*, *d*, *e*, and *f*, four pouches, each containing a great number of embryos, these in *c*, *d*, and *f* being only represented in outline.